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(54) Wire lattice girder combinable with arc-welded steel mesh

(57) The present invention relates to a metal lattice girder made with wire and/or rod iron (1, 2, 3) of homogeneous and non-homogeneous cross section, of varied lateral structural composition, having the characteristic of being such as to hook up by means of the bent portions (7) of the lateral spacers (20) and combinable with arc-welded wire netting having square or rectangular meshes (17, 18). The tongs (19) with a claw hook (21) catch the upper longitudinal wire (1) of the lattice girder for transporting the girder and press laterally on the lateral spacers (20), bending them inwardly to allow them to be set down onto the wire (17) and guide the coupling of the bent portions (7) with the parallel wires (18) of the arc-welded steel mesh. This is achieved by releasing the force on the tongs (19) and, with the springback of the sides of the lattice girder, the terminals of the spacers hook up with the wires (18) of the mesh, locking in place and thereby forming a combined three-dimensional structure consisting of the wire lattice girder and arc-welded steel mesh.

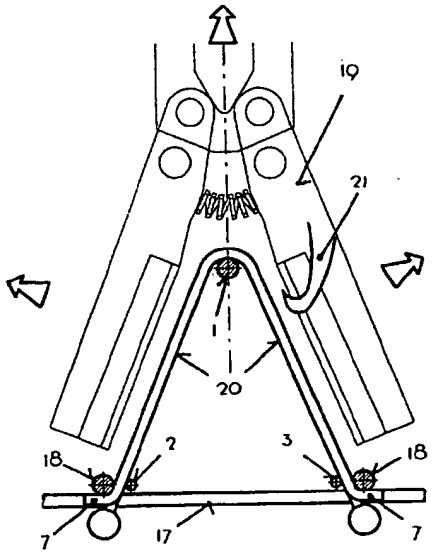

Fig.21

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Description

The present invention relates to a metal lattice girder made with wire and/or rod iron of homogeneous and non-homogeneous cross section, of varied structural composition, based on the mechanical characteristics required by the industrial designs, having the characteristic of being such as to hook up and combinable with arc-welded wire netting, with the possibility of being fixed thereon by means of arc-welding and/or binding, or not fixed thereon because they are sufficiently fixed in the modular assembly and to build generally a strong, load-bearing three-dimensional metal structure suitable for reinforced concrete castings, preferably for industrialized construction. Said lattice girders, having identical or variable form and dimensions in their structural construction phase, have a transversal cross section in the shape of an isosceles or equilateral triangle without the base, so that the sides are free to move nearer or away from each other (elastically). On the sides of the lattice girder, the metal spacers have, at their lower ends, bent portions or lateral projections (parallel or nearly parallel with the base) which have the purpose of adhering to and hooking up with the wires of the meshes in the arc-welded steel mesh, causing it to adhere to the shape of the lattice girder itself. In its transversal cross section, the lattice girder has a base free of spacers and a span that is the same or greater than the width of the meshes of the arc-welded steel mesh with which it will be interlinked. Taking advantage of the elastic properties of the metal material, the two sides of the lattice girder are pressed and subsequently inserted past said steel mesh, making the longitudinal wires adhere to the transversal wires of the mesh and keeping the lateral bent portions of the spacers past the parallel wires at the longitudinal wires. When the pressure is relieved on the sides of the lattice girder, as a result of the springback of the material the sides widen and in this manner the sides and the bent portions or lateral projections will adhere to the parallel wires of the steel mesh, hooking up therewith.

In the case of a horizontal lattice girder placed vertically (in transversal cross section) with the lower base supported on a horizontal steel mesh, the mesh will bear down with its own weight on the parallel wires of the meshes interlinked with the lateral bent portions of the lattice girders, thereby forming a three-dimensional combined product consisting of the steel mesh and lattice girder.

In the present state of the art, metal lattice girders for prefabricated elements for the building industry are normally made with a triangular cross section, with longitudinal wires parallel to each other at the triangle apexes of a length equal to the length of the lattice girder itself. These longitudinal wires are made integral to each other by the arc welding of spacer elements consisting of continuous and/or discontinuous wires. The whole reticulated structure displays a generally constant construction whereby at times, in order to enhance the mechanical strength of the lattice girder in a particular area and thus respond to the design requirements, additional reinforcing rod iron or wires are applied to strengthen the lattice girder in the areas that are subjected to greatest stress in the use thereof or during the phase of overall assembly of the reticulated structures before casting the concrete.

Said wire lattice girders are also applied at intervals with arc-welded steel mesh, cut to size, or they are placed above or below the arc-welded mesh before the casting, obviously after positioning and spacing the whole structure or cage, with suitable blocks of wood or other means, from the surface of the support base before the cast.

From the known techniques as briefly laid out above various problems have been found that affect particularly the manufacturing times of the construction of prefabricated elements and therefore also the consequent costs. Among the main problems there is the absence of the possibility, in the known automatic construction of the lattice girder structure, of varying the reticular structure itself. In fact, the structure of the lattice girders is constructed uniformly without variations, and therefore if along its length it is to respond to different stresses, as it often happens, in the present state of the art it is built along its whole length in the forms and dimensions provided for according to the maximum expected stresses (resulting in waste of materials), or the lack of mechanical strength is overcome with additional reinforcing rods applied in the caging phase.

Another problem is the mechanical binding between the arc-welded steel mesh and the lattice girder, which are two separate and distinct elements.

Therefore, the objective has been to perfect an arc-welded reticular metal lattice girder that would overcome all the above-mentioned problems, further providing additional advantages to increase its versatility and greatly reduce production times for prefabricated construction elements or building constructions in general. The three-dimensional wire lattice girder designed as a resistant structure for concrete castings according to the present invention consists essentially of the conventional three parallel reinforcing rods arranged triangularly and making up the longitudinal elements of the lattice structure. Said three elements comprise the vertexes of a triangle and are held integrally to each other, two by two, by arc-welded continuous or discontinuous wires or by interlinking all three while, however, leaving the third side free. The connection of the reinforcing rods to each other along the lattice girder is achieved in various manners using different types of spacers based on the mechanical characteristics to which the lattice girder must respond along its length. These spacer elements consisting of wires will be arc welded to the reinforcing rods having the function of longitudinal wires. They have a geometrical configuration of plain type, in the case of straight sections that join the longitudinal

wires, two by two, at right angles or obliquely thereto (in one direction or the other), or of complex type in the case of longer wire or reinforcing rods, bent and shaped in a "V", "N", "M", "W" or simply in a zig-zag pattern. Also, the connection of the longitudinal wires can be achieved with wire elements bent in a "V" shape involving the longitudinal wires in a perpendicular or oblique manner.

Accordingly, different types of spacers will be arc welded along the three longitudinal wires, depending on their mechanical characteristics, which will have to respond to the requirements of resistance of the lattice girder as a whole.

These spacers between the longitudinal wires have two characterizing features: the first is the possibility of bending one end portion of the spacer wires, the lower one, outwardly so as to provide a stopping projection; the second characteristic is the extension of the lower end past the arc-welded point on the longitudinal wire, downward, in order to provide the end with a terminal in the form of a sphere or other geometrical shape, made of plastic, wood or other material suitable for the purpose.

Not all the spacers of the lattice girder longitudinal wires are of the type with the end bent outwardly nor are they all of the type with the projecting end holding a terminal. It is sufficient to place them in an alternating or successive arrangement variously combined in order to have them separately distributed over the whole length of the lattice girder.

The lattice girder constructed in this manner has a transversal cross section in the shape of a triangle (isosceles or equilateral), with the three longitudinal wires connected to each other by the spacers on two (oblique) sides while leaving the third side (the base) free. This makes it possible to press and bend the two oblique sides, approaching them to each other, so as to be able to insert the lattice girder with the bent ends of the spacers into the meshes of an arc-welded steel mesh. More specifically, by positioning the two lower longitudinal wires of the lattice girder perpendicularly onto the transversal wires of the mesh and simultaneously relieving the compression force applied on the two sides of the lattice girder (springback), the lateral projections of the outwardly bent spacers will insert themselves beyond the parallel wires of the meshes on the steel mesh, this way locking the three-dimensional lattice girder to the, generally flat, arc-welded steel mesh. In this manner, the lattice girder is connected to the steel mesh and at the same time it itself functions (e.g., in the case of horizontal steel mesh and upper lattice girder) as a support and a discrete spacing element from a lower support surface, with the (ball-shaped) terminals projecting downward.

With the present invention, in addition to enabling the construction of a lattice girder that is responding to the load requirements through the variations (in direction, cross section and shape) of the spacers connecting the three longitudinal wires along the whole length of the lattice girder it is also possible to achieve the result, through pressure and bending and the subsequent springback of the two oblique sides of the lattice girder, of locking the same straight lattice girder onto a flat arc-welded steel mesh and of supporting it spaced away from a support surface.

The interruption of continuity of the spacers between the longitudinal wires has the purpose of diversifying their functions (of anchoring and supporting the steel mesh in position) and at the same time achieving a lattice girder meeting the requirements of design (mechanical strength).

The arc-welded three-dimensional lattice girder will be built automatically on suitable machines capable of characterizing every individual product in the various versions in order to respect the required technical characteristics.

Some preferred embodiments of the present invention are illustrated by way of example but not by way of limitation in the four tables of drawings attached hereto, wherein:

- Fig. 1 is a side view of a three-dimensional lattice girder with three parallel longitudinal wires, with spacers of varied geometrical configuration and function;
- Fig. 2 is a side view of a portion of lattice girder showing three types of "V" shaped spacers with exterior upper longitudinal wire;
- Fig. 3 is a transversal cross-sectional view of the lattice girder taken along line A-A of Fig. 2, showing the spacer of "V" type with the outwardly bent ends;
- Fig. 4 is a transversal cross-sectional view of the lattice girder taken along line B-B of Fig. 2, showing a plain spacer of "V" type connecting the three longitudinal wires in oblique position;
- Fig. 5 is a transversal cross-sectional view of the lattice girder taken along line C-C of Fig. 2, showing the spacer of "V" type with ends projecting downward and provided with ball-shaped terminals;
- Fig. 6 is a side view of a portion of lattice girder showing three types of "V" shaped spacers placed on the outside of the three longitudinal irons;
- Fig. 7 is a transversal cross-sectional view of the lattice girder taken along line D-D of Fig. 6, showing the outside-placed "V" shaped spacer with the outwardly bent ends;
- Fig. 8 is a transversal cross-sectional view of the lattice girder taken along line E-E of Fig. 6, showing a plain outside-placed spacer of "V" type connecting the three longitudinal wires in oblique position;
- Fig. 9 is a transversal cross-sectional view of the lattice girder taken along line F-F of Fig. 6, showing the spacer of "V" type with ends projecting downward and provided with ball-shaped terminals;
- Fig. 10 is a side view of a portion of a lattice girder having three types of continuous spacers laterally

connecting the three longitudinal wires;

- Fig. 11 is a transversal cross-sectional view taken along line G-G of Fig. 10 showing the spacer of plain type joining two longitudinal wires;
- Fig. 12 is a transversal cross-sectional view taken along line H-H of Fig. 10 showing the spacers with the outwardly bent ends;
- Fig. 13 is a transversal cross-sectional view of the lattice girder taken along line I-I of Fig. 10, showing the spacers provided with ball-shaped terminals;
- Fig. 14 is a side view of a portion of a lattice girder having three types of spacers consisting of cut spacers of wire or reinforcing rods;
- Fig. 15 is a transversal cross-sectional view taken along line L-L of Fig. 14 showing the spacers of cut pieces type joining two longitudinal wires;
- Fig. 16 is a transversal cross-sectional view taken along line M-M of Fig. 14, showing the spacers of cut pieces type with outwardly bent lower ends;
- Fig. 17 is a transversal cross-sectional view of the lattice girder taken along line N-N of Fig. 14, showing the spacers of cut pieces type with projecting lower ends provided with ball-shaped terminals;
- Fig. 18 is a transversal cross-sectional view of the lattice girder before the lateral pressure phase;
- Fig. 19 is a transversal cross-sectional view of the lattice girder hooked during the phase of lateral pressure and elastic bending along the free side;
- Fig. 20 is a transversal cross-sectional view of the lattice girder pressed and placed on the arc-welded steel mesh having wires parallel to the lattice girder, placed above the perpendicular support wires;
- Fig. 21 is a transversal cross-sectional view of the lattice girder in the phase of release of the pressing action and consequent springback with coupling of the outwardly bent ends of the spacers with the parallel wires of the meshes of the arc-welded steel mesh at the longitudinal wires and subsequent disengagement;
- Fig. 22 is a transversal cross-sectional view of the lattice girder with the lower longitudinal wires at a higher level before the phase of lateral pressure and insertion onto a steel mesh of opposite type or positioned perpendicularly with respect to the one represented in the previous figures;
- Fig. 23 is a transversal cross-sectional view of the lattice girder hooked during the phase of lateral pressure and elastic bending along the free side;
- Fig. 24 is a transversal cross-sectional view of the lattice girder pressed and placed on the perpendicular wires of the arc-welded steel mesh;
- Fig. 25 is a transversal cross-sectional view of the lattice girder in the phase of release of the pressing action and consequent springback with coupling of the outwardly bent ends of the spacers with the parallel wires of the meshes of the arc-welded steel mesh at the longitudinal wires and subsequent disengagement.

As can be seen from the enclosed figures, the combinable three-dimensional arc-welded wire lattice girder includes three parallel longitudinal wires (1, 2, 3) placed in the pattern of a triangle (preferably isosceles or equilateral) and connected to each other in a variably combined manner by means of arc-welded wires while leaving the base side completely free. This connection results in an integral structure and for this purpose are used cut spacers of wire bent and formed in a "V" shape (4, 5, 6) that join the three longitudinal wires, with the upper longitudinal wire externally positioned (1), or (9, 10, 11) with all the longitudinal wires (1, 2, 3) positioned internally in the geometrical figure. Other types of spacers can be used, such as separate straight cut spacers of wire (14, 15, 16) or bent cut spacers of wire (12, 13), which join the longitudinal wires two by two while always leaving the base side free.

These different examples of spacers of varied configurations, of continuous or discontinuous type (like the cut spacers of wire) are used to construct a structural composition that responds to the requirements of mechanical strength of the lattice girder. Accordingly, along the length of the lattice girder it is possible to provide an arrangement of spacers that are stronger (thickness, geometrical shape) at the points where the lattice girder is subjected to greater mechanical stresses, and vice-versa to provide an arrangement of spacers that are less strong (thickness dimensions, less sturdy geometrical shapes) at the points where the lattice girder is subjected to smaller stresses. In this manner, the lattice girders are characterized on the basis of the required mechanical performance.

Further, some spacers exhibit two other characteristics that enhance the performance of the lattice girder. The first is embodied in a bent portion (7) at the lower end of the spacers, projecting outwardly, preferably parallel to the free base of the triangle (transversal cross section of the lattice girder) (4, 9, 12, 15). The second characteristic consist of the extension of the lower ends of some of the spacers on which are mounted support terminals in the shape of a small sphere (8) or of other geometrical configuration, of plastic material or other material suitable for the purpose (6, 11, 13, 16).

Not all the spacers are provided with the above-mentioned characteristic; along the length of the lattice girders they are variedly positioned (alternatively with or without continuity), based on the length of the lattice girder. The lattice girder so constructed, therefore, has a triangular cross-sectional shape with one side, the base, free of spacers, so that by applying pressure with force (by means of suitable tongs 19 after latching with a hook 21) on the oblique sides (20), the same sides are bent inwardly and the two base longitudinal wires are brought closer to each other. In this manner, the lattice girder can be coupled to a flat arc-welded steel mesh with square or rectangular meshes having wires (17) that are perpendicular to the lattice girders and wires (18) that are parallel thereto. The latter are positioned

above the former wires (17) or vice-versa for upside-down steel mesh or with perpendicular position of the lattice girders. The lower longitudinal wires (2, 3) of the lattice girder pressed closer to each other will rest on the wires (17) of the steel mesh, and when the pressure is released on the two oblique sides (20) they will tend to spread apart (due to the intrinsic elasticity of the material) and thus causing the laterally bent stopper elements (7) of the spacers to be inserted past the wires (18) of the steel mesh. In this manner, the three-dimensional lattice girder is anchored and hooked to the wires (18) of the arc-welded steel mesh. In the case of a lattice girder positioned perpendicularly to the previous description, the two base longitudinal wires of the lattice girder will be positioned at a higher level to allow the bent portions (7) to be anchored to the wires (18) of the mesh at a lower level, or the terminals of the spacers will be made longer and more projecting.

On the other hand, the function of the ball-shaped lower terminals (8) is to space the whole three-dimensional structure so constructed, that is, the lattice girder or girders together with flat (or differently shaped) arc-welded steel mesh, from a lower support surface. This is particularly useful, and represents a considerable economy of time, in the production of prefabricated construction elements involving the manufacture of products obtained from reinforced concrete castings in formworks and in which the meshed wire reinforcing structure is perfectly positioned at a distance from the external surface.

Obviously, if the composition of the arc-welded steel mesh (17, 18) and lattice girder (1, 2, 3) is to be transported and handled, for greater assurance it is advisable to tie it or arc-weld the lattice girder to the steel mesh, in order to avoid the accidental detachment of the joining or connecting parts.

The composition of the lattice girder and the arc-welded steel mesh can be the most varied; for example, three-dimensional meshed structures can be constructed with lattice girders of identical or different length positioned parallelely and/or perpendicularly to each other, and all connected to the arc-welded steel mesh, following parallelely the square and/or rectangular meshes.

Claims

1. Wire lattice girder combinable with arc-welded steel mesh, characterized in that it is made up of at least three or more longitudinal wires made of reinforcing rods and/or wire with a homogeneous or a non-homogeneous cross section, placed parallel to each other and comprising, in a transversal cross section, the apexes of a triangle having one side completely free of the lateral spacers joining the longitudinal wires. The spacers that stiffen the structure join the longitudinal wires perpendicularly and/or obliquely two by two or all three (or more) at the same time, leaving however one side free.

   Said lateral spacers are continuous and/or discontinuous (cut spacers of wire and/or reinforcing rod) of varied geometrical configuration and arc welded to the longitudinal wires in the various combinations along the whole length of the lattice girder (leaving the longitudinal wires internal and/or external on the composition). Some of the lateral joining spacers display at their ends, toward the free side of the triangle, characterizing projections which are of bent type (7) and/or of extended type with spacing terminal (8). The former regards an orthogonal bent portion of the projection outwardly (7), preferably parallel to the base of the cross-sectional triangle. The latter concerns an extension of a few centimetres of the spacer end, beyond the free side of said triangle, with a ball-shaped terminal made of other material (8) or other geometrical configuration fixed thereto with the function of support.
   Said lattice girder, preferably of triangular cross section, has a side (the base) that is free of spacers, whereby, using appropriate handling tongs, it is possible to press the two oblique sides provided with spacers and push them closer to each other, thereby bringing the two base longitudinal wires to adhere to the perpendicular wires of the arc-welded steel mesh, and, subsequently, by the removal of the action of said pressing force (assisted also by the springback of the sides), the lateral projections (7) of the spacer wires of the structure being positioned past the parallel wires of the mesh will engage therewith thus interlocking the entire three-dimensional structure with the steel mesh.
   Simultaneously, the projections (8) of the lattice girder spacers, the ones provided with terminals serving as points of support, will position the entire three-dimensional structure, consisting of the lattice girder and steel mesh, spaced from a support surface.

2. Wire lattice girder combinable with steel mesh as claimed in claim 1, characterized in that the lateral spacers joining the longitudinal wires are made of arc-welded wire and/or reinforcing rods, of continuous type and/or of cut spacers of various lengths and of "V" and/or "M", and/or "N", and/or "W" shape arranged uniformly or variously alternated and/or combined along the entire length of the lattice girder.

3. Wire lattice girder combinable with steel mesh as claimed in claim 1, characterized in that both the perpendicular and/or oblique spacers joining the

longitudinal wires are provided with ends, toward the free side of the triangle or base, that are bent outwardly (perpendicularly) forming stopper elements, and/or are projecting with or without spacing terminals, and/or simply projecting.

4. Wire lattice girder combinable with steel mesh as claimed in claim 1, characterized in that it can be associated, in multiples thereof, with a steel mesh in a parallel and/or perpendicular arrangement, in like manner to the configuration of the meshes.

5. Wire lattice girder combinable with steel mesh as claimed in claim 1, characterized in that it includes four reinforcing rods serving as parallelely arranged longitudinal wires roughly forming in transversal cross section the vertexes of a rectangle or square, three sides of which are provided with spacers and one is free, to allow the sides to be bent inwardly and favour the interlinking of bent stopper elements (7) of spacers with the parallel wires of the mesh.

6. Wire lattice girder combinable with steel mesh as claimed in claim 1, characterized in that, in its transversal cross section, it can be provided with any geometrical configuration including with a number of longitudinal wires (for example, a greater number) that is different from the number of the sides of said figure.

7. Wire lattice girder combinable with steel mesh as claimed in claim 1, characterized in that it is interlinkable with the wires of the steel mesh that are parallel to the longitudinal wires and arranged at a pitch that is the same or a submultiple of the width of the free side of the lattice girder, that are suitable for interlocking with the lateral stopper elements of the lattice girder spacers.

8. Wire lattice girder combinable with steel mesh as claimed in claim 1, characterized in that, in the case of upside down steel mesh or perpendicular arrangement of the lattice girder, or with the longitudinal wires (2, 3) of the lattice girder base set down on the perpendicular wires (17) of the arc-welded steel mesh arranged at a higher level than the anchoring parallel wires (18) that are at a lower level, said lattice girder will be built with the base longitudinal wires at a higher level, at a distance that is closer to the head longitudinal wire (1), or will have the lower ends of the lateral spacers, the bent ones (7) and the projecting ones (8), longer in relation to the thickness of the reinforcing rods that make up the arc-welded mesh.

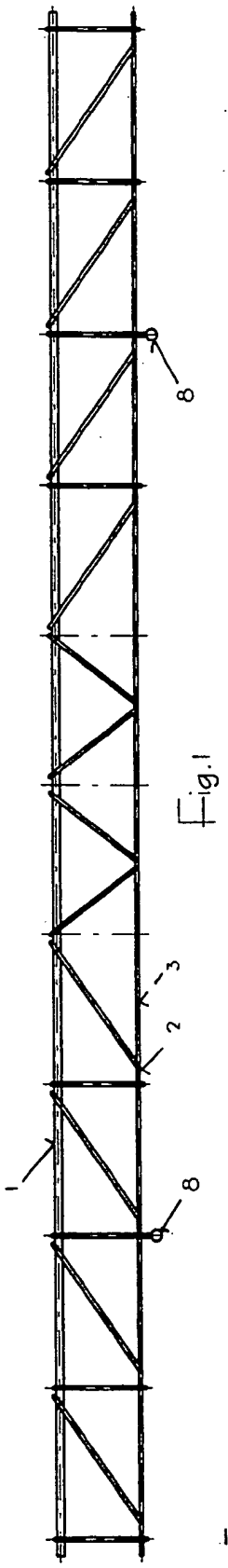

Fig.1

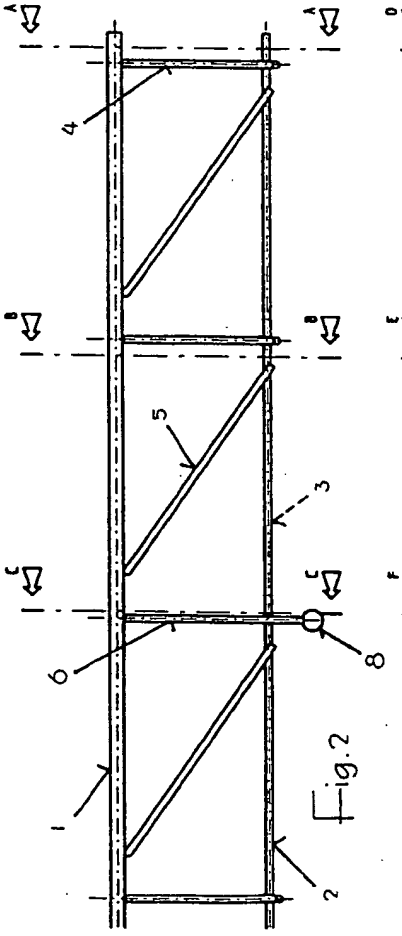

Fig.2

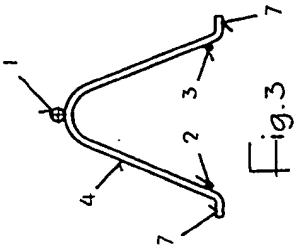

Fig.3

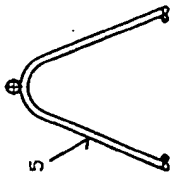

Fig.4

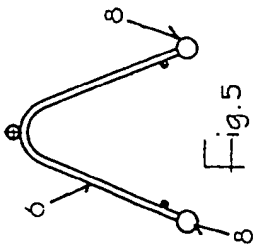

Fig.5

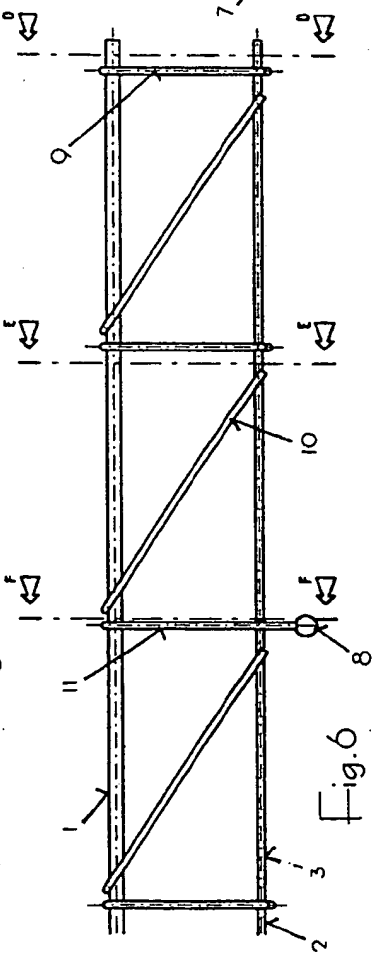

Fig.6

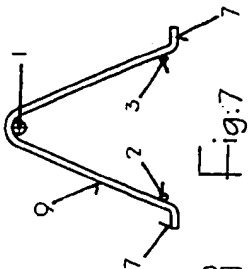

Fig.7

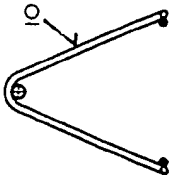

Fig.8

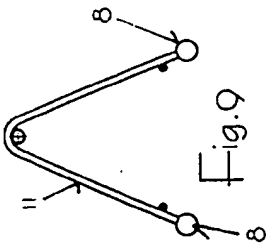

Fig.9

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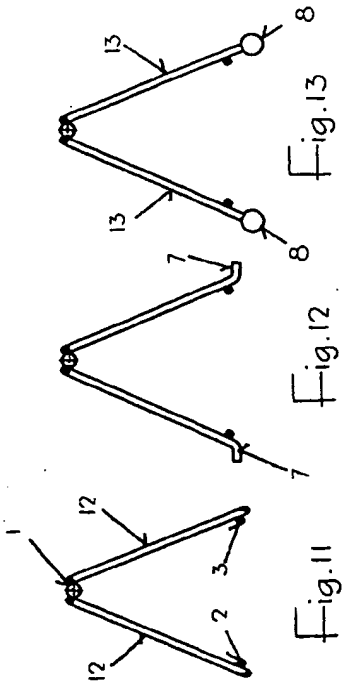

Fig.13

Fig.12

Fig.11

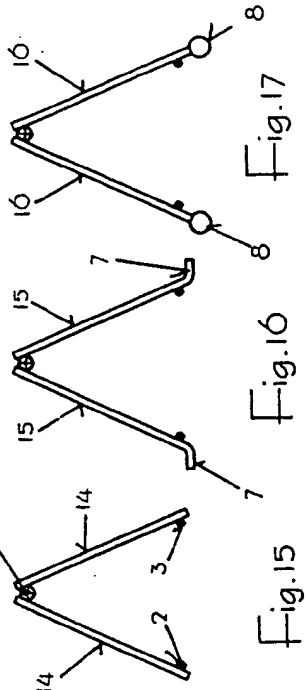

Fig.17

Fig.16

Fig.15

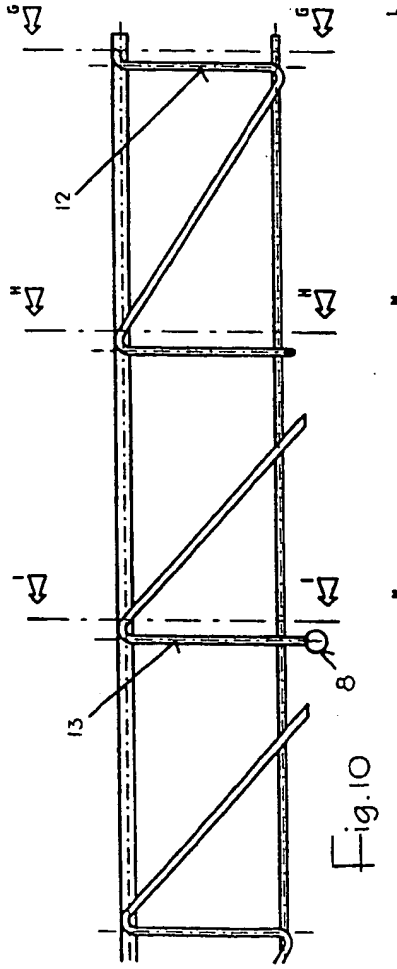

Fig.10

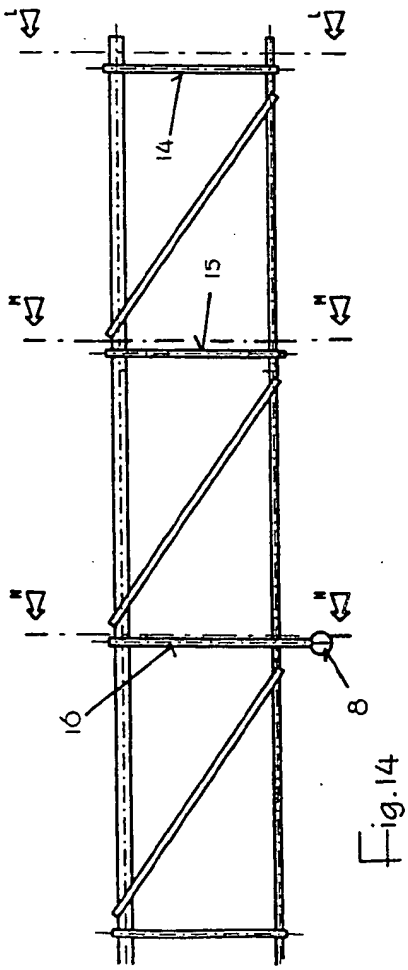

Fig.14

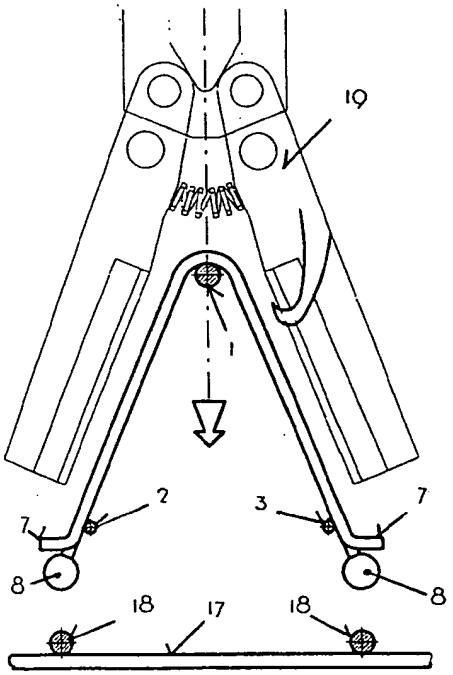

Fig.18

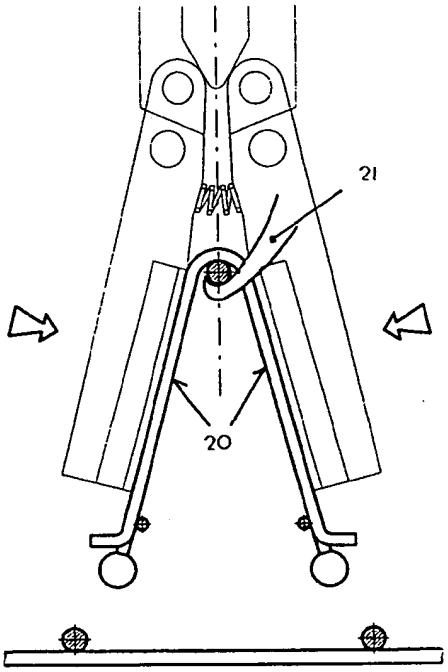

Fig.19

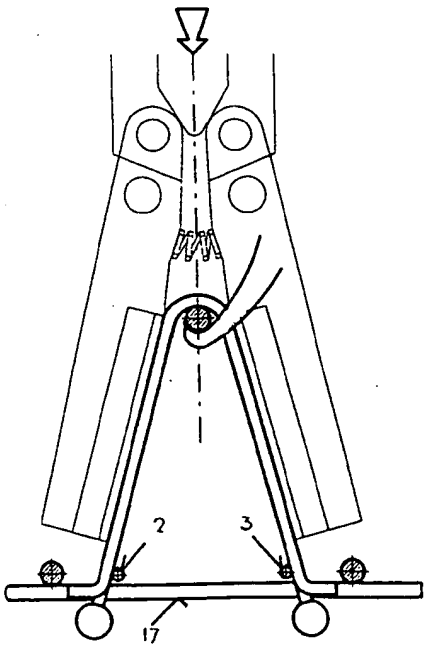

Fig.20

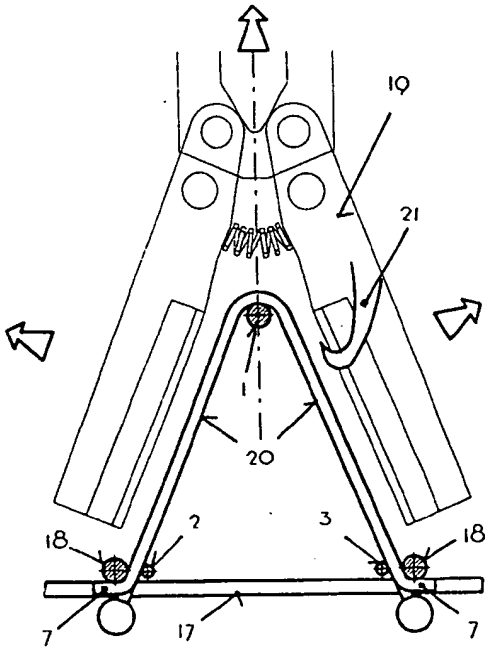

Fig.21

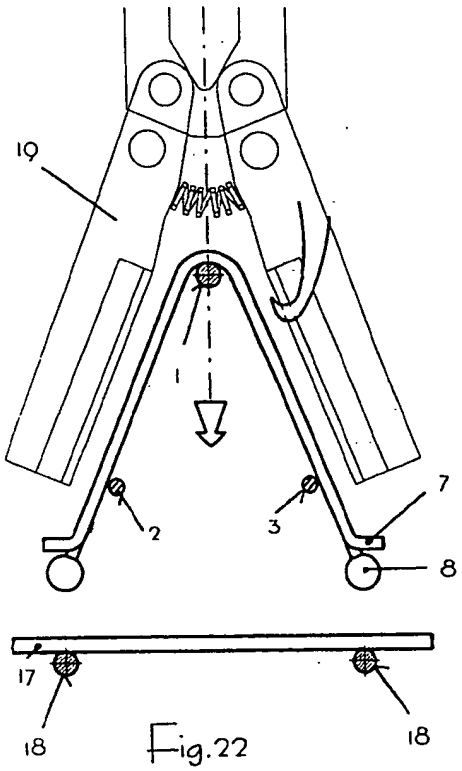

Fig.22

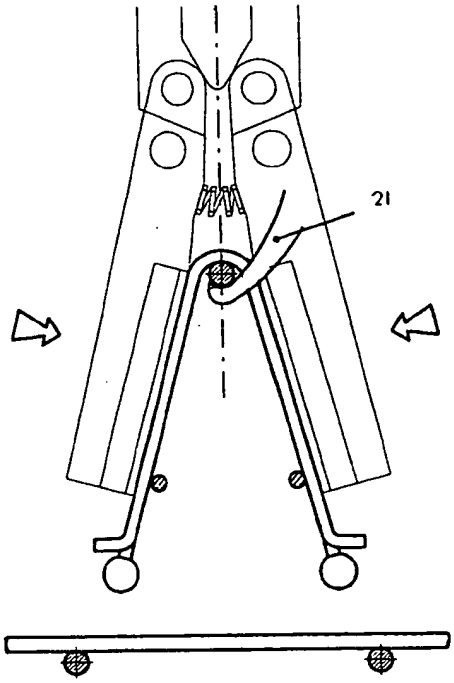

Fig.23

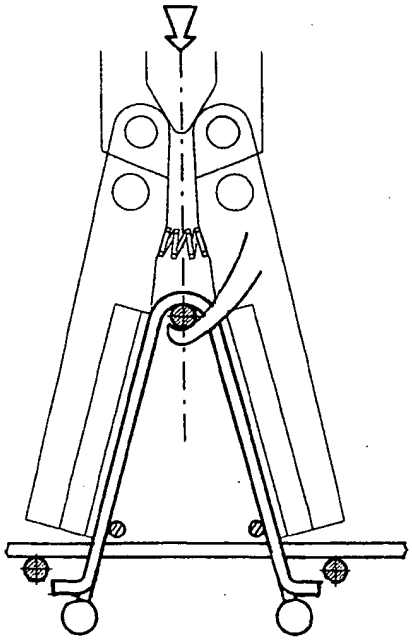

Fig.24

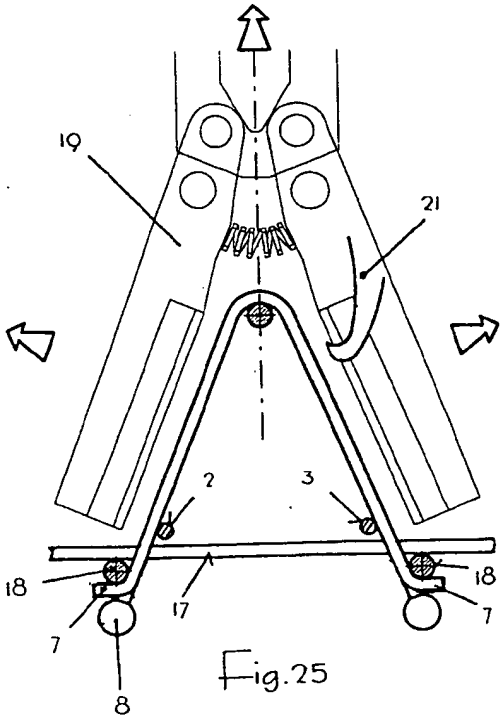

Fig.25

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(54) Wire lattice girder combinable with arc-welded steel mesh

(57) The present invention relates to a metal lattice girder made with wire and/or rod iron (1, 2, 3) of homogeneous and non-homogeneous cross section, of varied lateral structural composition, having the characteristic of being such as to hook up by means of the bent portions (7) of the lateral spacers (20) and combinable with arc-welded wire netting having square or rectangular meshes (17, 18). The tongs (19) with a claw hook (21) catch the upper longitudinal wire (1) of the lattice girder for transporting the girder and press laterally on the lateral spacers (20), bending them inwardly to allow them to be set down onto the wire (17) and guide the coupling of the bent portions (7) with the parallel wires (18) of the arc-welded steel mesh. This is achieved by releasing the force on the tongs (19) and, with the springback of the sides of the lattice girder, the terminals of the spacers hook up with the wires (18) of the mesh, locking in place and thereby forming a combined three-dimensional structure consisting of the wire lattice girder and arc-welded steel mesh.

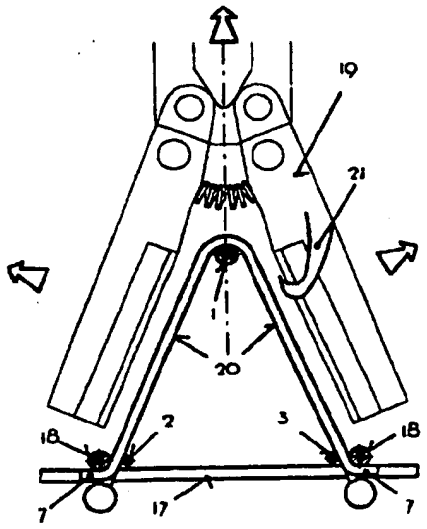

Fig.21

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EUROPEAN SEARCH REPORT

Application Number
EP 98 10 2581

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y A	DE 37 06 611 A (ERTL ADOLF) 8 September 1988 * column 4, line 14 - column 7; figures *	1 2-4,7	E04C5/06
Y A	DE 20 55 460 A (RHEINBAU GMBH) 8 June 1972 * page 4, last paragraph - page 7, paragraph 2; figures 1-4 *	1 2-4,7	
A	DE 24 01 297 B (KELLER) 12 June 1975 * column 3, line 44 - column 4, line 29; figures 4,5 *	1-4,7	
A	DE 27 59 229 A (WOCHNER SEBASTIAN KG) 5 July 1979 * page 13 - page 17; figures *	1-4,7	
A	DE 37 07 792 A (ERTL ADOLF) 22 September 1988 * column 4; figures *	1-4,7	
A	WO 95 22669 A (AVI ALPENLAENDISCHE VERED ;RITTER GERHARD (AT); RITTER KLAUS (AT);) 24 August 1995 * page 4, line 35 - page 5, column 24; figure *	1,2,4	TECHNICAL FIELDS SEARCHED (Int.Cl.6) E04C
A	EP 0 649 948 A (WEBER HAUS GMBH & CO KG) 26 April 1995 * column 5, line 31 - column 7, line 16; figures *	1-4	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	11 November 1998	Paetzel, H-J

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